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EFFECTS BASED OPERATIONS WARGAMING SIMULATION (EBOWS)

L-3 Communications Analytics Corporation

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13. ABSTRACT *(Maximum 200 Words)*

The complexities of 21st century warfare have emphasized a need for skilled analysts in the Air and Space Operations Center (AOC) and, by extension, the tools to support them. In response to this, the Air Force Studies and Analysis Agency (AFSAA) has launched "The Analyst in the AOC Initiative" to "Deploy Operations Research Expertise to Support the War Fighter." Similarly, Air Force Research Laboratories (AFRL), Rome NY, initiated an Advanced Technology Demonstration to develop new capabilities for implementing Effects-Based Operations (EBO) Planning, Execution, and Assessment, with the long-term vision of fielding a "Dynamic Tasking Toolkit that Supports EBO" in the AOC. EBOWS is the wargaming component of this toolkit. Its role is to assess the relative merits of competing Courses of Action (COA) within an operational context and provide the Campaign Planner with results that are detailed and accurate enough to support decision-making. EBOWS models significant aspects of Aerospace, Land, and Naval warfare. It not only provides campaign planners with insights into the impact of their decisions upon future operations, it does so with sufficient detail for analysts to trace unexpected results back to a root cause.

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Wargaming, Effects-based Operations (EBO), Air Operations Center (AOC), Campaign Planners, Planning, Execution, and Assessment, Scheduling, Course of Action

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TABLE OF CONTENTS

1.0 OBJECTIVE:

The objective of this effort is to explore the utility of employing advanced analytical simulation technology applications to improve the effectiveness and efficiency of air campaign planning in an operational environment. The purpose of the effort is to enable Air Force operational planning to evolve to effects-based operations (EBO) War-game Simulation.

2.0 SCOPE:

The scope of this effort is to design, develop and demonstrate an Effects-Based Operations Wargaming Simulation (EBOWS) Tool. EBOWS is an integral part of an EBO Concept of Operations (CONOPS) that embraces planning, execution and assessment functions for EBO. EBOWS will fill the role of the Wargaming simulation Tool identified in the AFRL EBO Toolkit Architecture. The design and development effort will culminate in a proof-of-concept demonstration of the initial prototype implementation of the EBOWS Tool. The desired environment for the demonstration was JEFX 2004. Should that environment not be available, demonstration of the EBOWS prototype will be undertaken in an environment identified by the contractor in concert with AFRL.

3.0 BACKGROUND:

The complexities of 21st century warfare have emphasized a need for skilled Analysts in the Air and Space Operations Center (AOC) and, by extension, the tools to support them. In response to this, the Air Force Studies and Analysis Agency (AFSAA) launched “The Analyst in the AOC Initiative” to “Deploy Operations Research Expertise to Support the War

Fighter." Similarly, Air Force Research Laboratories (AFRL), Rome, NY, initiated an Advanced Technology Demonstration to develop new capabilities for implementing Effects-Based Operations (EBO) Planning, Execution, and Assessment, with the long-term vision of fielding a "Dynamic Tasking Toolkit that Supports EBO" in the AOC.

3.1 EBOWS is the Wargaming component of the EBO toolkit. Its role is to assess the relative merits of competing Courses of Action (COA) within an operational context and provide the Campaign Planner with results that are detailed and accurate enough to support decision making. A fully developed EBOWS models significant aspects of Aerospace, Land, and Naval warfare. It not only provides Campaign Planners with insights into the impact of their decisions upon future operations, it does so with sufficient detail for Analysts to trace unexpected results back to a root cause.

3.2 Today, at the strategic and operational levels, current guidance plus existing and forecasted capabilities do not provide commanders with adequate techniques to focus on the effects required to achieve control over an adversary. Commanders of campaigns, joint operations and Air Expeditionary Task Forces (AETFs) need methods to rapidly plan, assess, replan and execute their operations under conditions of uncertainty. In order to meet military objectives in the most efficient manner, improved strategy development, campaign planning & assessment, scheduling, and targeting tools are required.

3.3 The goal of the effects-based operations technology opportunity is to develop new concepts, tactics and tools to support an effects-based operations strategy. Effects-based operations are those set of processes, supported by tools and done by people in organizational settings that focus on planning, executing and assessing military activities for the effects they produce rather than the targets or even objectives they deal with. The advantages of effects based over target-based and objectives-based strategies include both economy of force (quicker, more decisive, and lower cost) and the probability of reduced collateral damage. Effects-based operations complement rather than replace target-based or objectives-based approaches. They are very amenable to mission-type orders and strategy options that do not emphasize attrition-based approaches. EBO applies across the entire range of military missions from humanitarian relief operations, peace making or enforcement operations or conventional war. **It** applies whether lethal or non-lethal, kinetic or potential force is used. EBO is not platform specific.

3.4 Effects-based operations complement rather than replace target-based or objectives-based approaches. They are very amenable to mission-type orders and strategy options that do not emphasize attrition-based approaches. EBO applies across the entire range of military missions from humanitarian relief operations, peace making or enforcement operations or conventional war. **It** applies whether lethal or non-lethal, kinetic or potential force is used. EBO is not platform specific.

3.5 At the heart of the AFRL EBO Program is an EBO Concept of Operations Document (CONOPS) that presents an EBO model. The goal of

the EBO model is to provide a framework that helps Commanders identify and predict how actions taken by our forces will lead to the direct and indirect effects required to defeat the enemy or perform other missions. The EBO model leverages and extends existing models used for planning, execution and assessment. It augments them to a) support dynamic tasking across planning, execution and assessment, b) explicitly incorporate a model of the enemy-as-a-system and enemy reactions, and c) support economy of force via the specification and analysis of the interconnections between target system/centers of gravity to determine indirect effects.

3.6 The AFRL EBOWS Program will formulate the EBO concept within a Wargaming environment and then build techniques and tools for warfighting commanders to implement the process. The resulting product from this initiative will assist commanders in building Joint Aerospace Operations Plans that focus on targeting to achieve the specific effects required to achieve control over an adversary as opposed to destruction.

3.7 Dynamic tasking for Effects Based Operations requires real or near-real time operational level war-gaming of blue vs. red courses of action (COAs). Software development is sorely needed to build a robust, computerized operational level war-gaming tool. This tool will take blue COA options such as those generated by the Air Force Research Lab's Strategy Development Tool (SDT) and war-game them against red COA options generated from some IPB (Intelligence Preparation of the Battle-space) tool or process. Today, COA vs. COA war-gaming if done at all is done on paper using situation and event templates. Most computerized

war-gaming tools such as STORM (Synthetic Theater Operations Research Model) have a force-on-force, target-attrition emphasis. Though they do support and analyze higher level objectives such as establish air supremacy, defeat warfighting forces, or disrupt enemy leadership; they are not adequate to satisfy EBO war-gaming requirements.

3.8 For war-gaming to support Effects Based Operations it has to account for criteria related to both friendly and adversary COAs. Adversary COAs are derived based on the process defined in Joint Publication 2-01.1, "Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battle-space". Determination of adversary COAs is the last step in a four-step process. This final IPB step includes 1. Identifying the adversary's likely objectives and desired end states, 2. Identifying the full set of COAs available to the adversary, 3. Evaluating and prioritizing each COA, and 4. Developing each COA in the amount of detail time allows. The process in JP 2-01.1 needs to be computerized with an explicit focus on EBO. For example, the document prescribes the use of psychological profiling of adversary leaders to determine their acceptable level of risk; but EBO will require broader cognitive modeling and behavioral analysis of not only warfighting decision making commanders, but also of political leadership and the general population. Friendly COAs built using AFRL's SDT tightly link commander's intent (objectives) to desired effects. The focus is explicitly on physical and behavioral effects including direct, indirect, cumulative and cascading effects. Centers of gravity and target analysis are used to identify targetable actions necessary to achieve the effects desired. Existing computerized war-gaming tools are limited in that they do not address the interplay of various COAs in a

simulated environment nor do they appropriately deal with effects. Most of these are highly robust when it comes to engagements (e.g., tanks against tanks or aircraft against armor forces) but are quite thin at the campaign level and of little use in evaluating an operational-level COA. Comparing attrition-based and operational-level wargames. Figure 1 illustrates the conventional force-on-force or "attrition-based" war-gaming process.

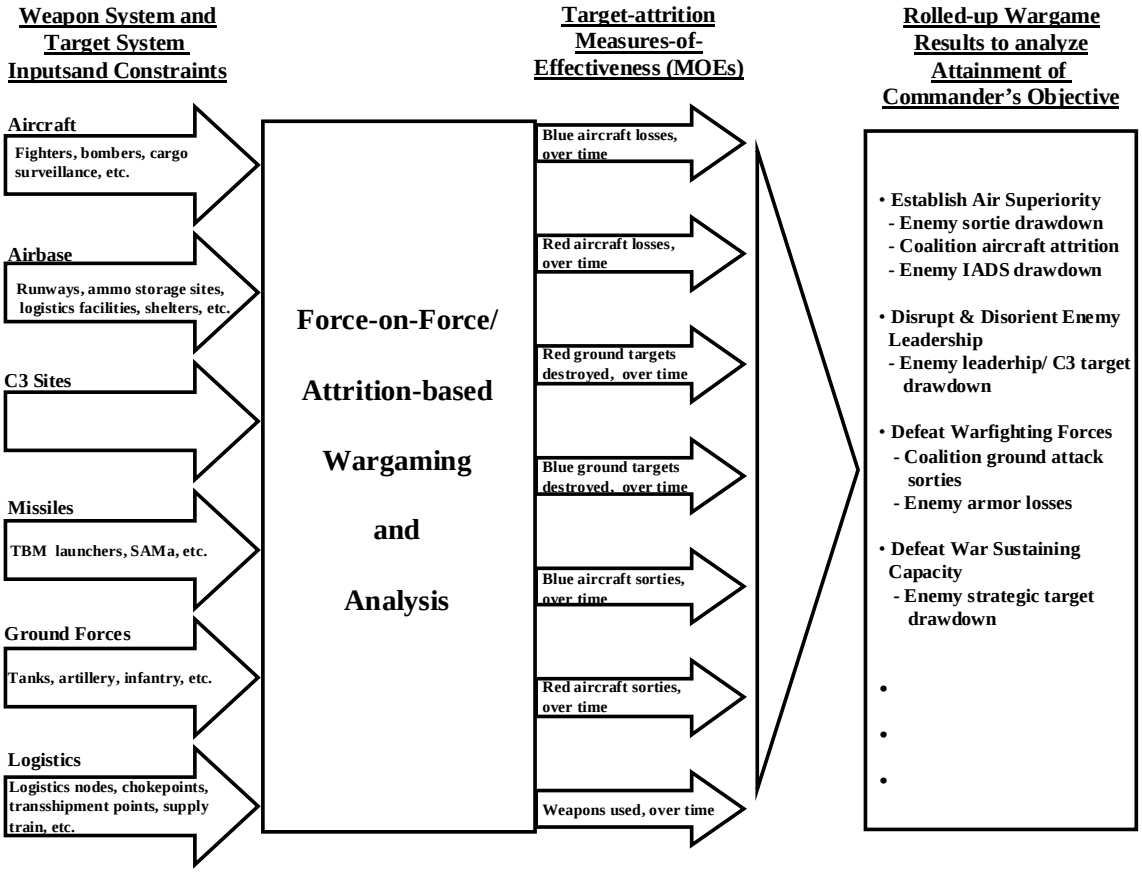

Figure 1. The Attrition-Based Wargaming Process

3.9 Tactical level weapon system and target system data and constraints are fed into the war-gaming tool. This includes information relative to the numbers and types of aircraft and missiles, ground force and air base composition, and logistics information. Conventional war-gaming tools

analyze these attributes and simulate tactical engagements. The results are target-attrition Measures of Effectiveness (MOEs) such as those shown, e.g. blue and red aircraft losses over time. Attrition-based MOEs are rolled-up to simulate whether or not commander's objectives have been met.

3.10 Figure 2, below, illustrates the operational-level, COA vs. COA EBO war-gaming process. The main objective of operational level war-gaming is to provide the commander with the information he needs to choose among various COA options.

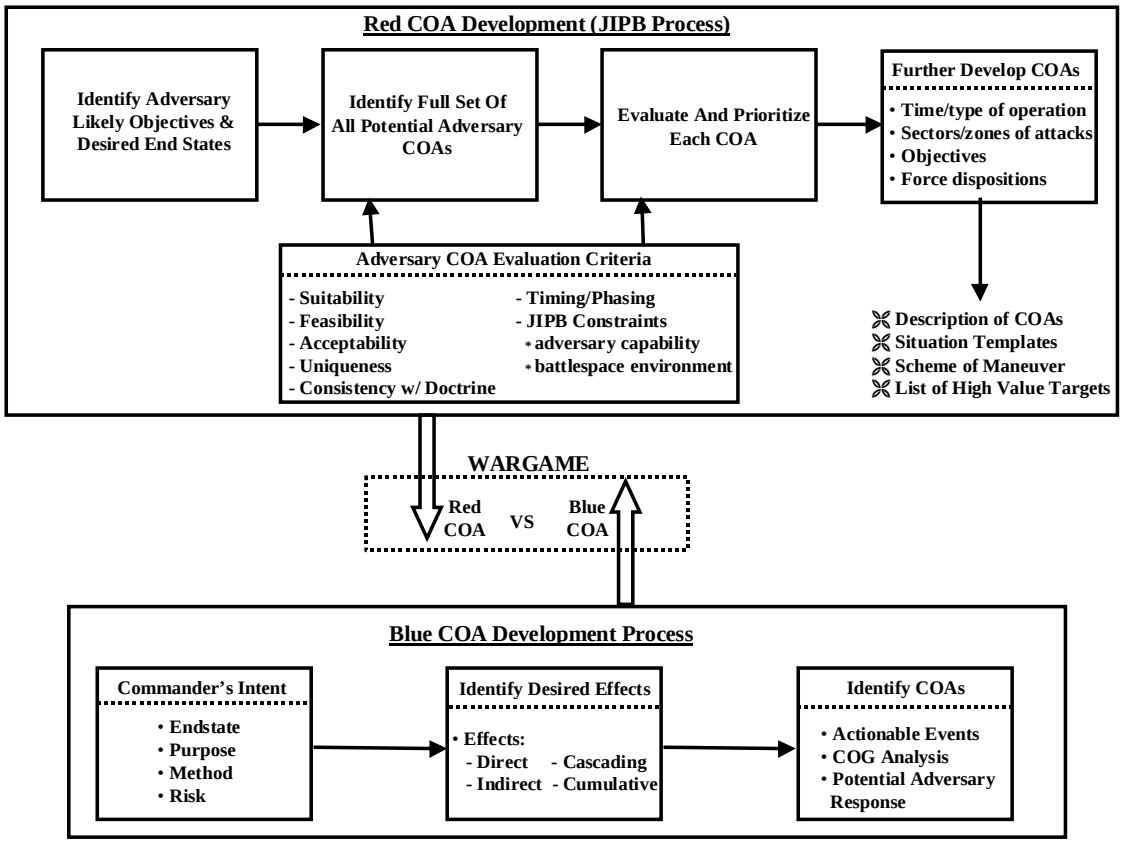

Figure 2. The Operational-Level, COA vs. COA EBO Wargaming Process

4.0 Technical Challenges:

As many of the prioritized adversary COAs as time permits should be taken into account and war gamed against the blue COAs generated. At the very least, the most likely and the most dangerous adversary COAs should be war gamed against three potential blue COAs. The technical challenge exists to develop an automated capability to play out COA vs. COA war games in a simulated and dynamic environment. Wargaming should visualize the flow of the operation accounting for friendly and adversary strengths, assets, possible COAs and the battle-space environment. Wargaming supports the "what-if" of COA development. Branches are normally developed around what-if scenarios. For example, "What if, in response to our planned actions, the adversary reacts in such-and-such a manner? What will we do in response?

Technical challenges related to operational-level war-gaming are summarized as follows:

4.1 Operational-level war-gaming is not automated. The need for such a tool exists to realize the vision for a dynamic tasking toolkit to support Effects Based Operations.

The need exists for real-time, operational-level war-gaming to support dynamic tasking during both execution and assessment. Wargaming speed and efficiency limit the amount of time available for war-gaming. The faster the war-gaming tool the more COA options that can be war gamed.

4.2 An effects-based focus needs to be factored into the COA development and war-gaming process. Wargaming needs to focus not

only on direct effects but also on indirect, cumulative and cascading effects. Modifications to existing doctrine also need to be addressed.

4.3 Cognitive and behavioral analysis methodologies need to be factored into war-gaming. How do we model and simulate the decisions of enemy leadership and those of the adversary's population. How is this accounted for in COA vs. COA war-gaming?

4.4 The inconsistency of data between entities comprising operational-level war games needs to be addressed. Model abstraction is required to combine center of gravity analysis models, COA models, and campaign assessment models.

4.5 User interfaces to operational-level war-gaming tools need to be built on a level consistent with the analyst’s level of expertise. There should not be a requirement to have a war-gaming specialist in an Air Operations Center.

5.0 Accomplishments:

5.1 Under this effort an Effects Based Operations Wargaming Simulation (EBOWS) software tool with STORM as the war-game engine was developed and delivered. The following paragraphs briefly describe the work done in developing EBOWS.

5.2 The Pacifica model was modified and upgraded for use by EBOWS as its core scenario. This model was modified to include Air to Surface Mission Planning algorithms that permit more than token “draw down” of

surface targets.

5.3 To populate the Pacifica model interfaces were developed to access Theater Battle Management Core Systems (TBMCS) Databases. These included compiled listings of Surface Targets and BLUE Air Order of Battle from the Operations Plan (OPLAN) and implementation of OCAP (Offensive Combat Air Patrol) mission within the model. Queried tables and fields of interest were identified within TBMCS databases for populating Pacifica within EBOWS. The process developed parsed listing of Strategic Surface Targets into Surface Target Datafile.

5.4 Templates were developed in EBOWS to coincide with Scenario Development Tool and Course of Action (SDT-COA) tool outputs, (i.e. Destroy SAMs, Destroy EW/GCI Radar, Destroy IADS C2, Destroy EP Substations, etc.). Pacifica and EBOWS models were updated to take advantage of Suppression of Enemy Air Defenses (SEAD) mission planning capabilities and to incorporate Alternatives Comparison Tool (ACT) and the Extended Markup Language (XML) Conversion Tool into EBOWS.

5.5 The SDT to EBOWS Parser was developed to permit communications between EBOWS and the SDT for COA data. Style sheets were developed to extract COA data from TBMCS for integration with Air Tasking Order (ATO) datafile between SDT and EBOWS and Parsed Target Lists into the Air Interdiction Plan (AIP) datafile.

5.6 The Data Conversion Tool which incorporates the SDT COA parser

and the TBMCS parser was completed and along with the data warehouse incorporated into EBOWS upon release of The Simulation Testing Operations Rehearsal Model (STORM) STORM v1.1 too store “Data of Interest” from EBOWS for implementation of ACT.

5.7 The framework for the presentation of the COAs Results within EBOWS was developed and incorporated into EBOWS. The ACT has been tested and demonstrated using AMOS mode and Graphic Software to support the EBOWS tool purchased. An Extended Markup Language (XML) parser was developed to process Air Operations Data Base (AODB) query results in for use by EBOWS.

5.8 The Simulation Testing Operations Rehearsal Model (STORM) which provides a synthetic environment for realistic operational testing within EBOWS to test COA’s developed using the SDT tool was incorporated within the overall simulation. STORM is the CORE operational war-game model within EBOWS. The STORM version used within EBOWS was flagged at v1.1.1. This version will remain fixed.

5.9 The contractor attended JEFX 04 Initial Exercises, participated in Scenario and JEFX spirals through April 2004, and Modeling & Simulation Working Groups in support of JEFX 04. During the lifetime of the contract the contractor presented EBOWS reviews to attendees of Conferences, Technical reviews at AFRL Rome, and as EBO reviews as part of the EBO team. As part of the EBO/JEFX team the contractor compiled listing of Surface Targets and BLUE Air Order of Battle from OPLAN to incorporate into Pacifica TBMCS Databases and parsed listing of Strategic Surface Targets into Surface Target Datafile (surfacetarget.dat).

5.10 The developed the Data Warehouse for storing EBOWS data. Continuously updated the surfaces target data to be stored in the Data Warehouse during the lifetime of the contract. The completed data warehouse was incorporated into EBOWS upon release of STORM v1.1. In addition, “Data of Interest” from EBOWS for implementation of ACT was stored in the Warehouse.

6.0 SUMMARY/CONCLUSION:

6.1 War-gaming to support Effects Based Operations has to account for criteria related to both friendly and adversary COAs. Adversary COAs are derived based on the process defined in Joint Publication 2-01.1, "Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battle-space". Determination of adversary COAs is the last step in a four-step process. This final IPB step includes 1. Identifying the adversary's likely objectives and desired end states, 2. Identifying the full set of COAs available to the adversary, 3. Evaluating and prioritizing each COA, and 4. Developing each COA in the amount of detail time allows. The process in JP 2-01.1 needs to be computerized with an explicit focus on EBO. Dynamic tasking for Effects Based Operations requires real or near-real time operational level war-gaming of blue vs. red courses of action (COAs). This effort, conducted by the Air Force Research Laboratory Rome Research site (AFRL/RRS) is the first step in the development of a robust, computerized operational level war-gaming tool. A tool that can take blue COA options such as those generated by the Air

Force Research Lab's Strategy Development Tool (SDT) and war-game them against red COA options generated from some IPB (Intelligence Preparation of the Battle-space) tool or process.